$$V_{RB} > V_{DD1}$$

Reverse Body Bias Voltage = V_{RB}

100

112
Reverse Body Biased Keeper

108
V_{DD1}

V_{DD1}

V_{DD1}

Clock 116

106
Pullup

104
Dynamic

Output

Inputs

Pulldown

Network

102

114

Foot- 110

Fig. 1. A footed domino logic circuit based on the reverse body biased keeper domino logic (RBBKD) circuit technique.
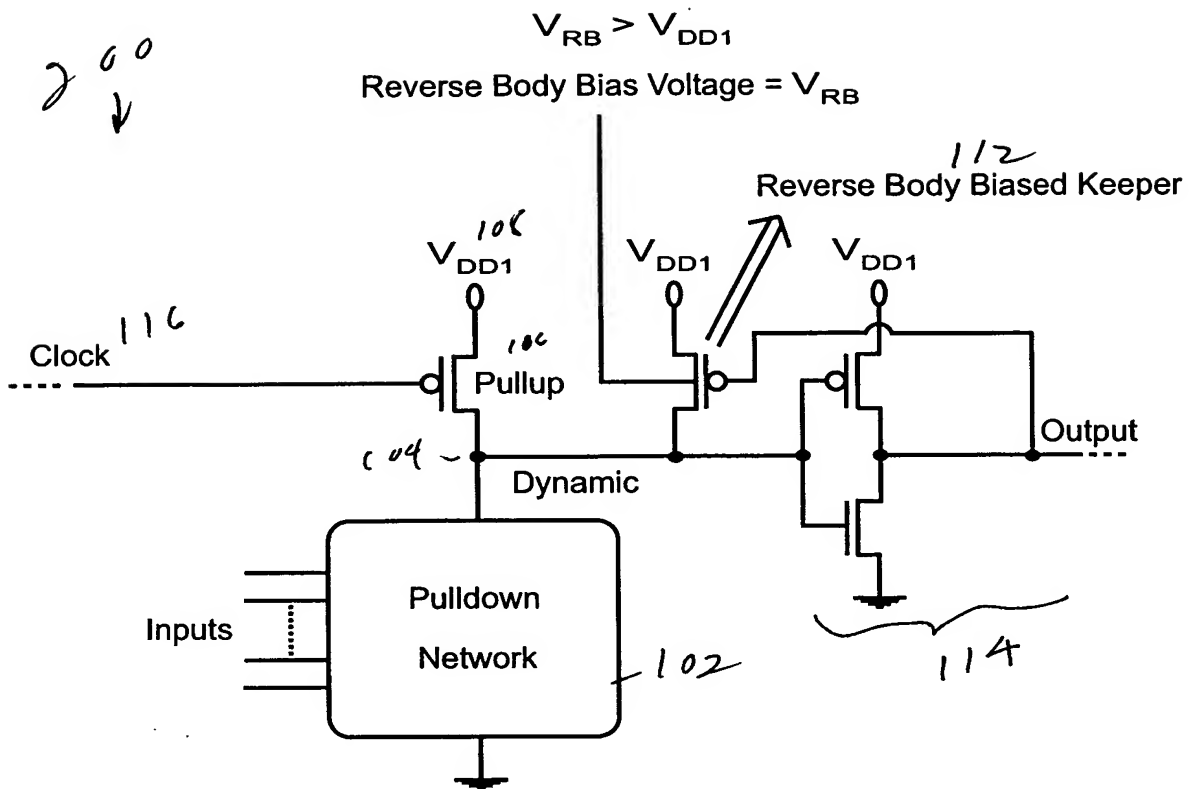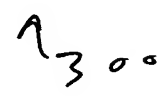
$V_{RB} > V_{DD1}$

Reverse Body Bias Voltage = V_{RB}

Reverse Body Biased Keeper

V_{DD1}

V_{DD1}

V_{DD1}

Clock

Pullup

Output

Dynamic

Inputs

Pulldown

Network

Fig. 2. A footless domino logic circuit based on the reverse body biased keeper domino logic (RBBKD) circuit technique.

Fig. 3. A footed domino logic circuit based on the dynamic reverse body biased keeper domino logic (DRBBKD) circuit technique.
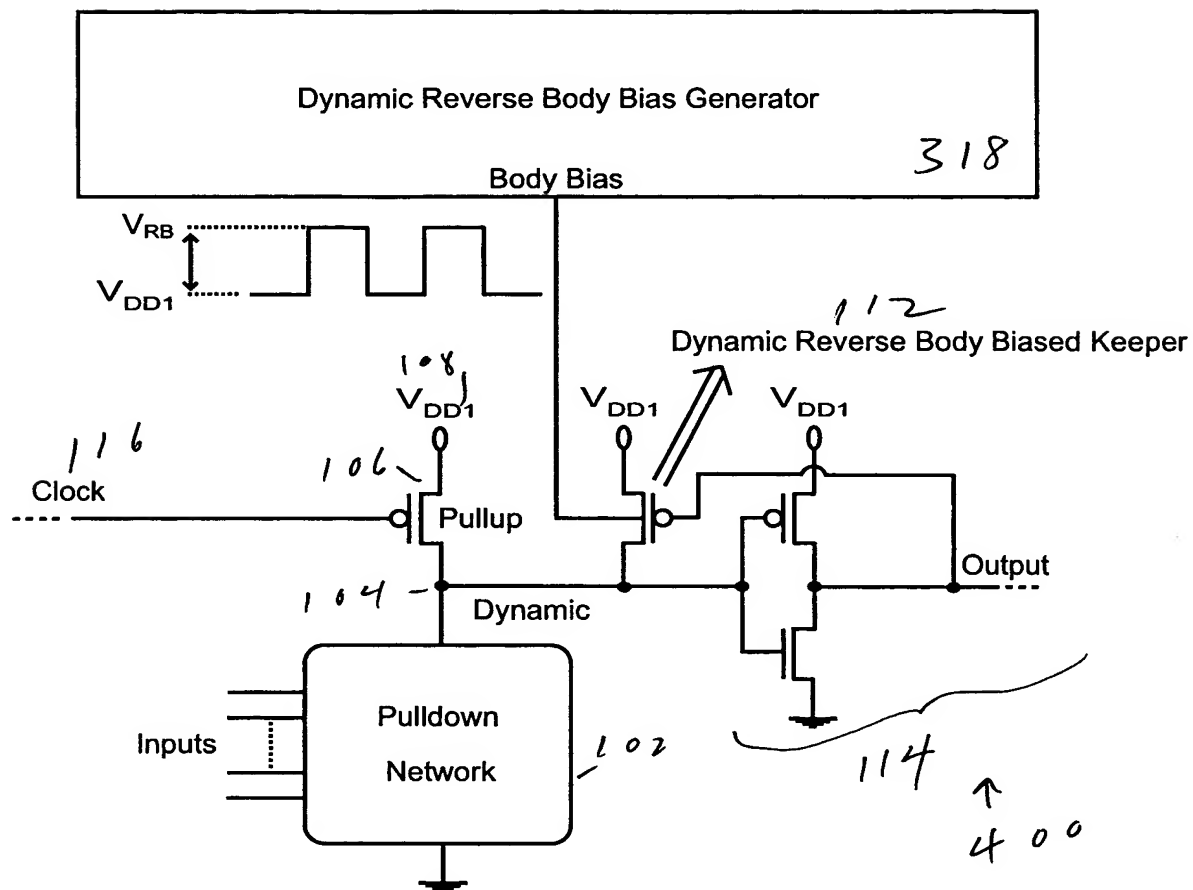
Fig. 4. A footless domino logic circuit based on the dynamic reverse body biased keeper domino logic (DRBBKD) circuit technique.
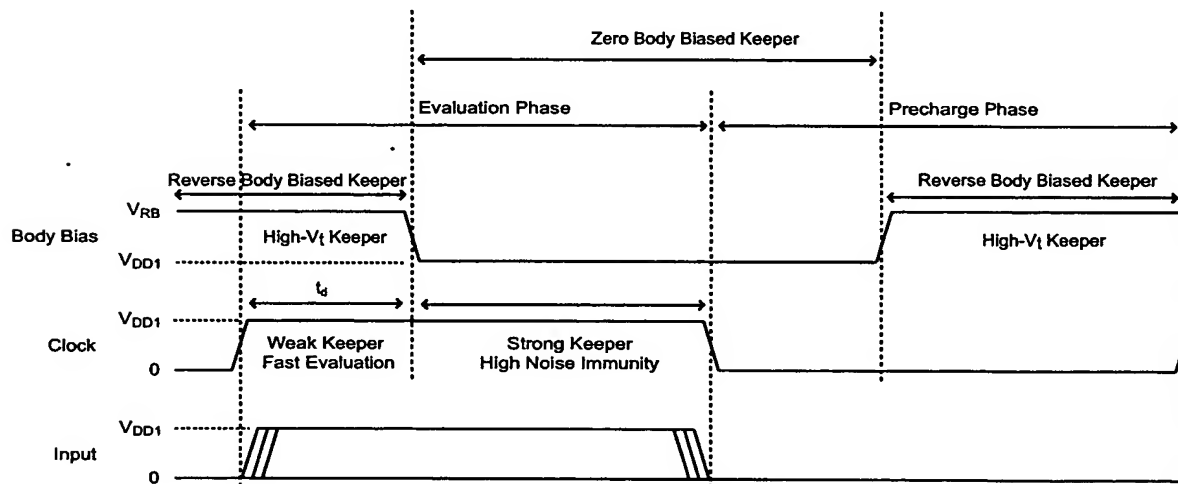

Fig. 5. Waveforms that characterize the operation of the proposed dynamic reverse body biased keeper domino logic (DRBBKD) circuit technique.
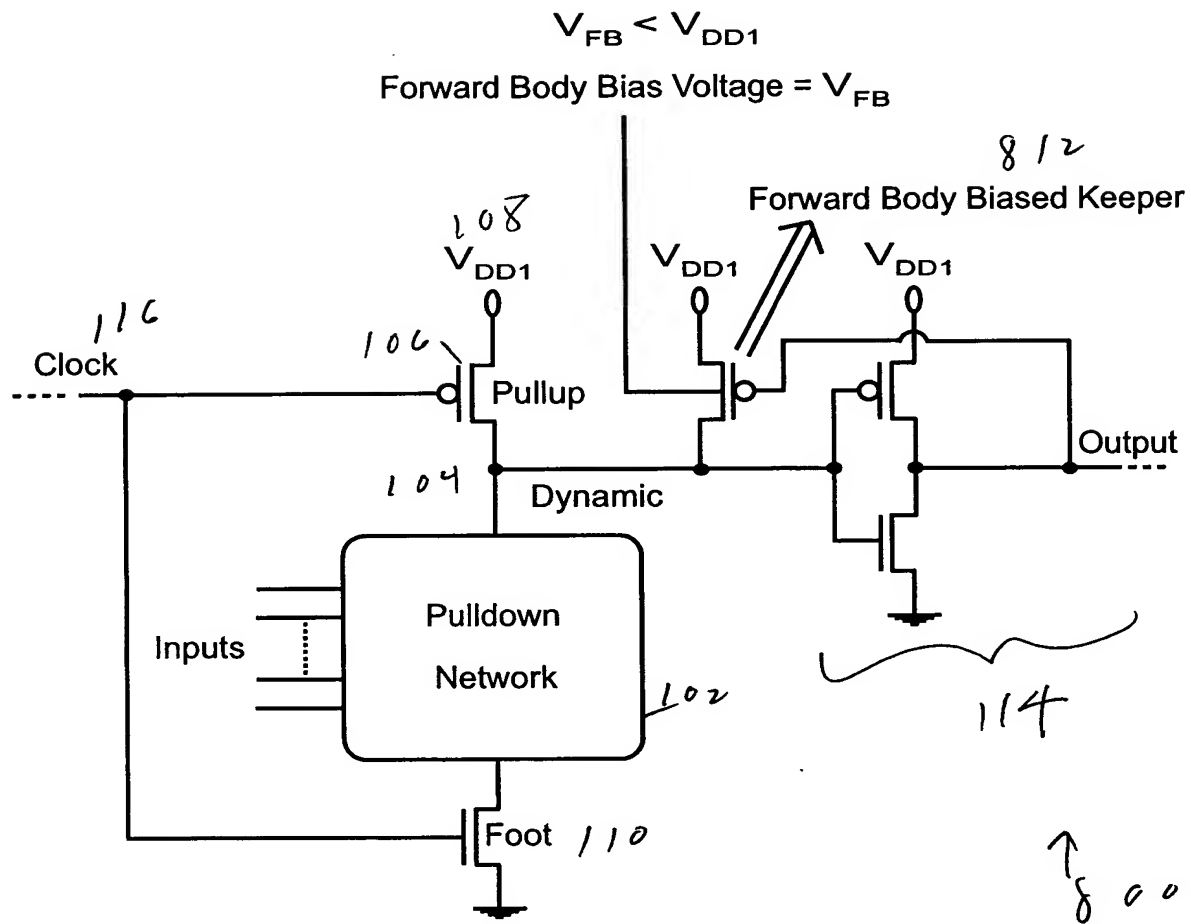
Fig. 6. A body bias generator applicable to the proposed dynamic reverse body biased keeper domino logic (DRBBKD) circuit technique [$V_{DD1} < V_{DD2}$ and $V_{tN3} < (V_{DD2} - V_{DD1})$].

Fig. 7. A body bias generator applicable to the proposed dynamic reverse body biased keeper domino logic (DRBBKD) circuit technique ($V_{DD1} < V_{DD2}$). The body of P_4 can be connected either to V_{DD2} or to $Node_3$ in order to not turn on the source-to-body diode of P_4 when $Node_3$ transitions to V_{DD2}.

$$V_{FB} < V_{DD1}$$

Forward Body Bias Voltage = V_{FB}

8/2

Forward Body Biased Keeper

108

V_{DD1}

V_{DD1}

V_{DD1}

116

Clock

106

Pullup

812

104

Dynamic

Output

Inputs

Pulldown

Network

102

114

Foot 110

800

Fig. 8. A footed domino logic circuit based on the forward body biased keeper domino logic (FBBKD) circuit technique.

$V_{FB} < V_{DD1}$

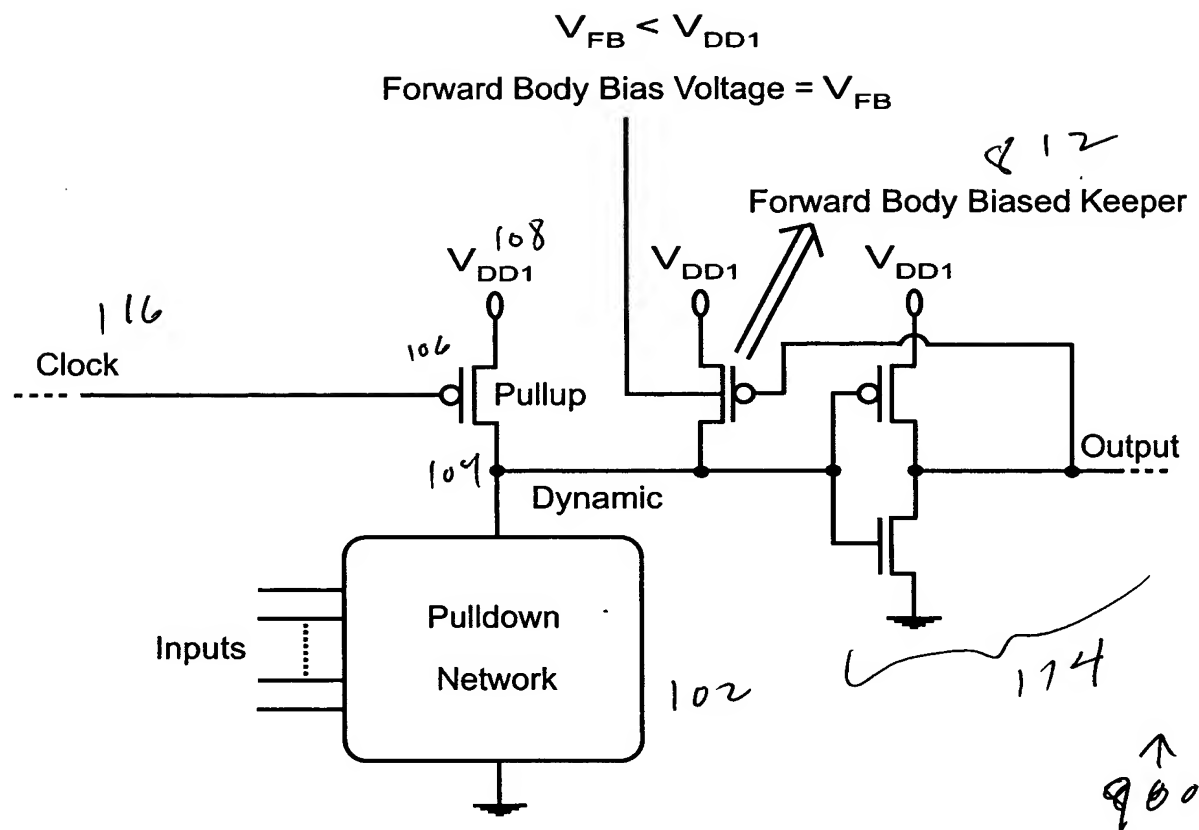Forward Body Bias Voltage $= V_{FB}$

Forward Body Biased Keeper

V_{DD1} V_{DD1} V_{DD1}

Clock

Pullup

Dynamic

Output

Inputs

Pulldown

Network
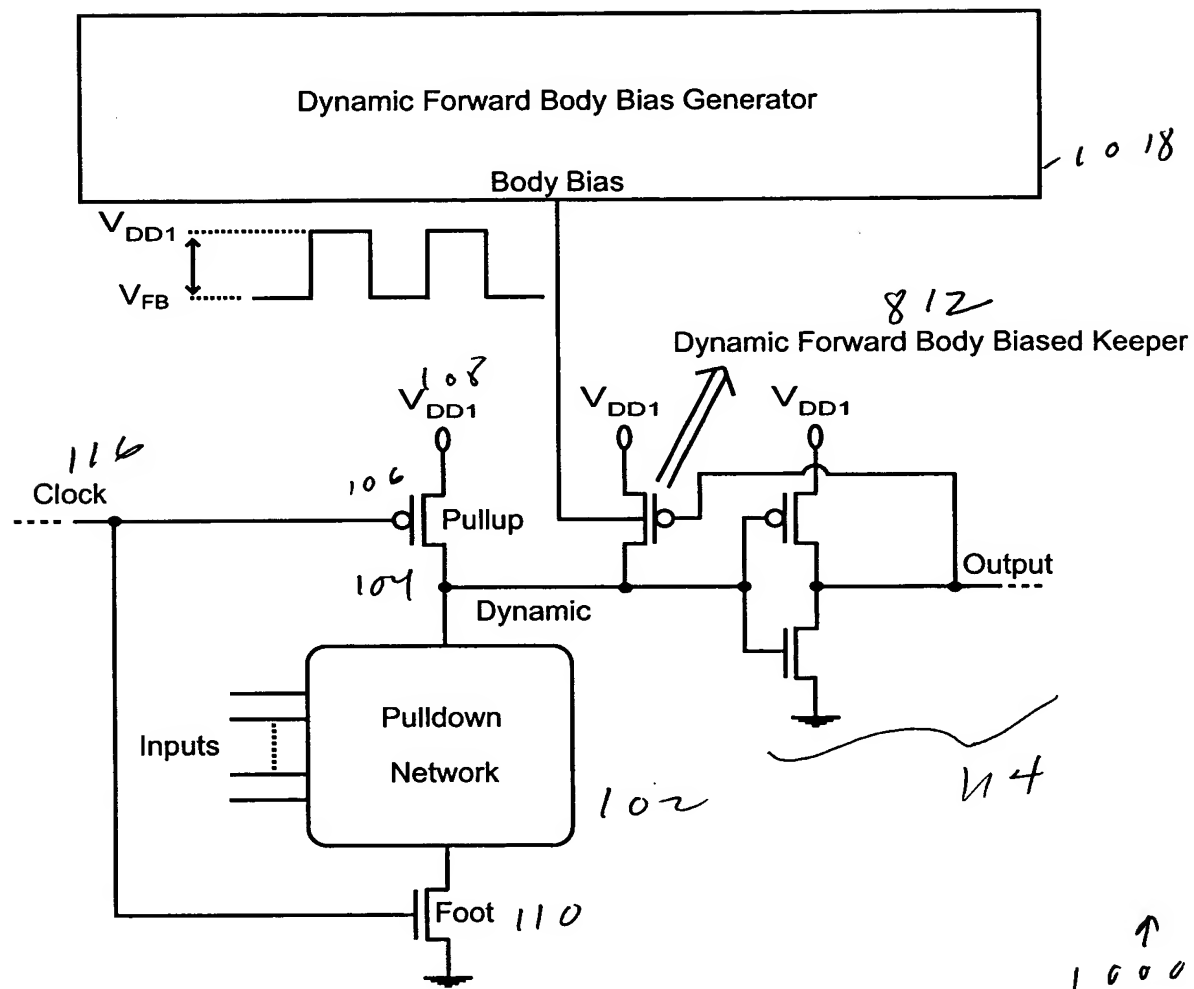
Fig. 9. A footless domino logic circuit based on the forward body biased keeper domino logic (FBBKD) circuit technique.

Fig. 10. A footed domino logic circuit based on the dynamic forward body biased keeper domino logic (DFBBKD) circuit technique.
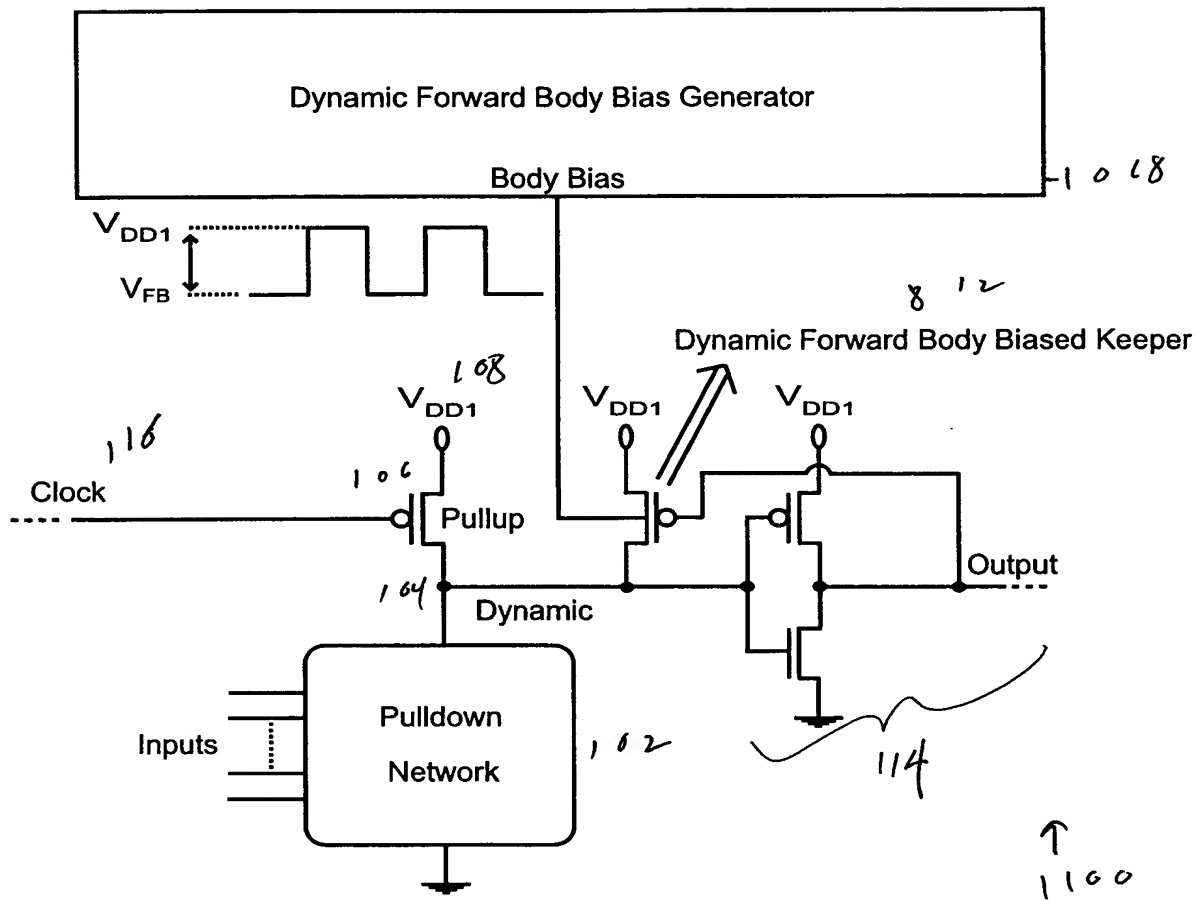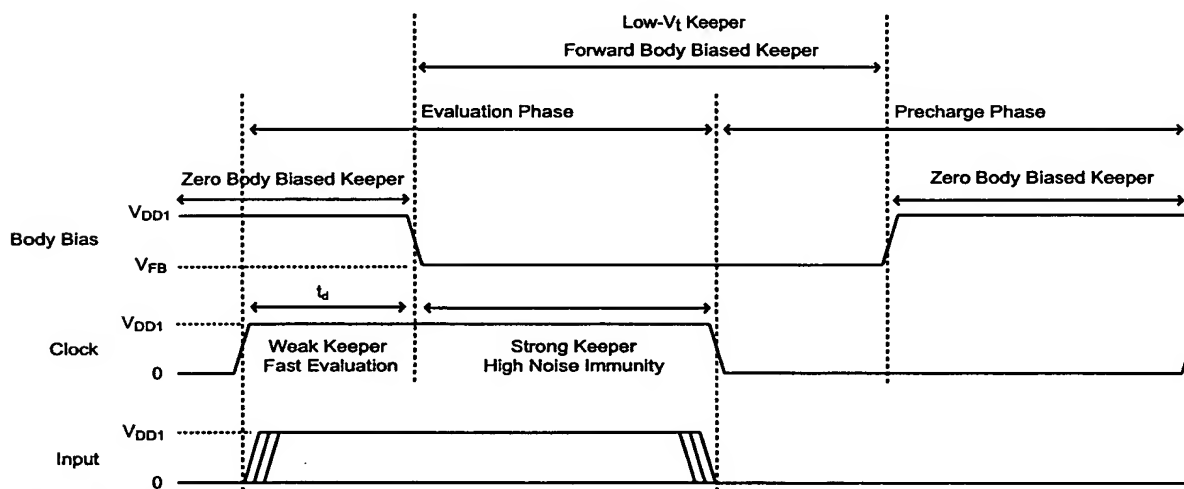
Dynamic Forward Body Bias Generator

Body Bias

V_{DD1}

V_{FB}

116

Dynamic Forward Body Biased Keeper

V_{DD1}

108

V_{DD1}

V_{DD1}

Clock

106

Pullup

104

Dynamic

Output

Inputs

Pulldown

Network

102

114

1100

Fig. 11. A footless domino logic circuit based on the dynamic forward body biased keeper domino logic (DFBBKD) circuit technique.

Fig. 12. Waveforms that characterize the operation of the proposed dynamic forward body biased keeper domino logic (DFBBKD) circuit technique.
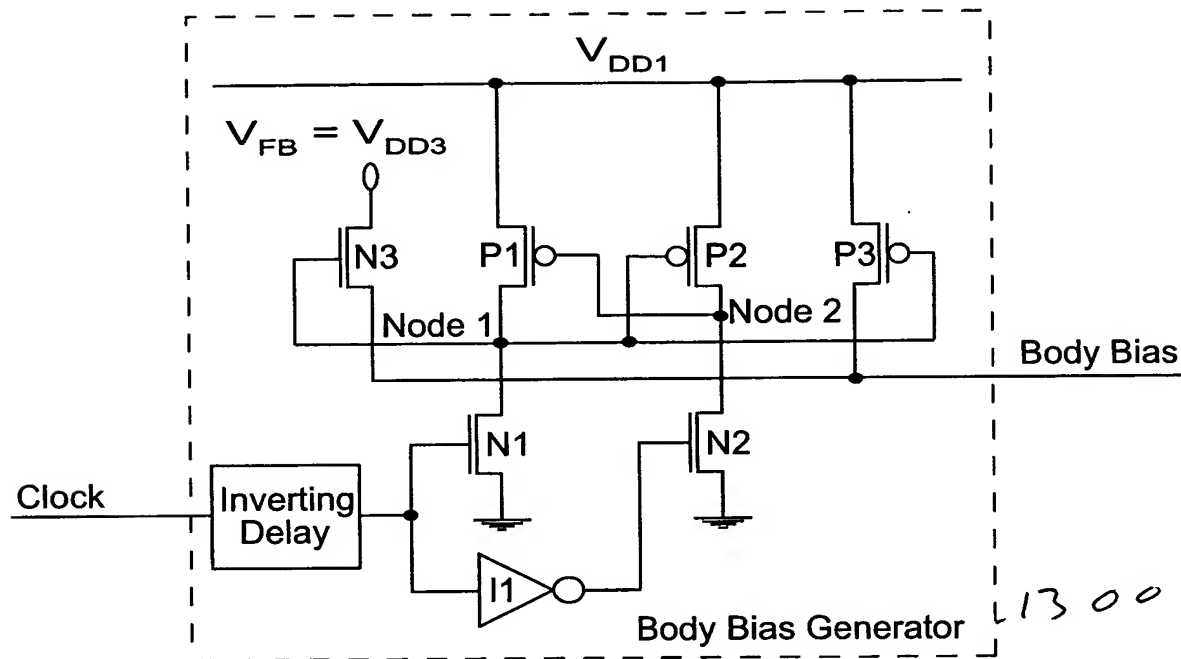
Fig. 13. A body bias generator applicable to the proposed dynamic forward body biased keeper domino logic (DFBBKD) circuit technique [$V_{DD3} < V_{DD1}$ and $V_{tN3} < (V_{DD1}-V_{DD3})$].
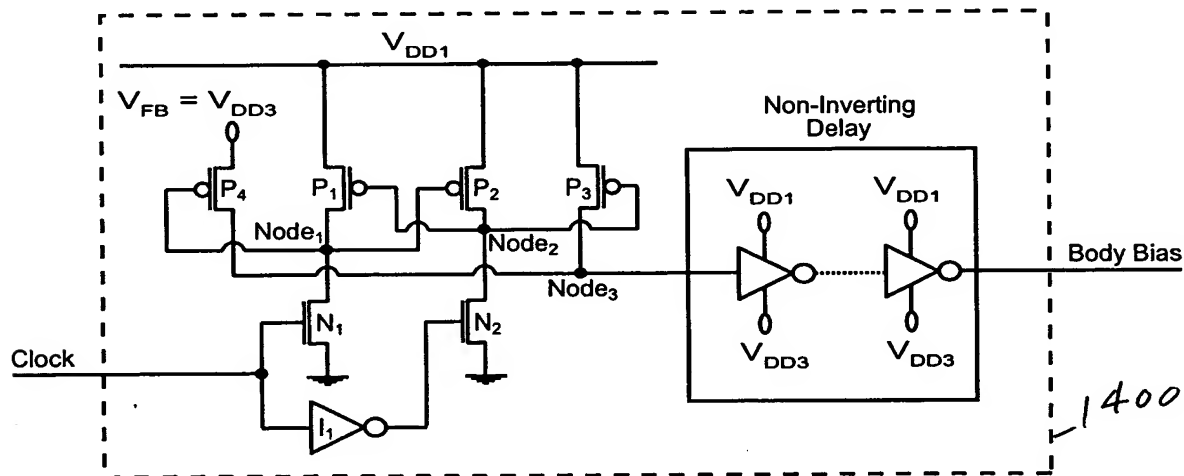

Fig. 14. A body bias generator applicable to the proposed dynamic forward body biased keeper domino logic (DFBBKD) circuit technique ($V_{DD3} < V_{DD1}$). The body of P_4 can be connected either to V_{DD1} or to $Node_3$ in order to not turn on the source-to-body diode of P_4 when $Node_3$ transitions to V_{DD1}.
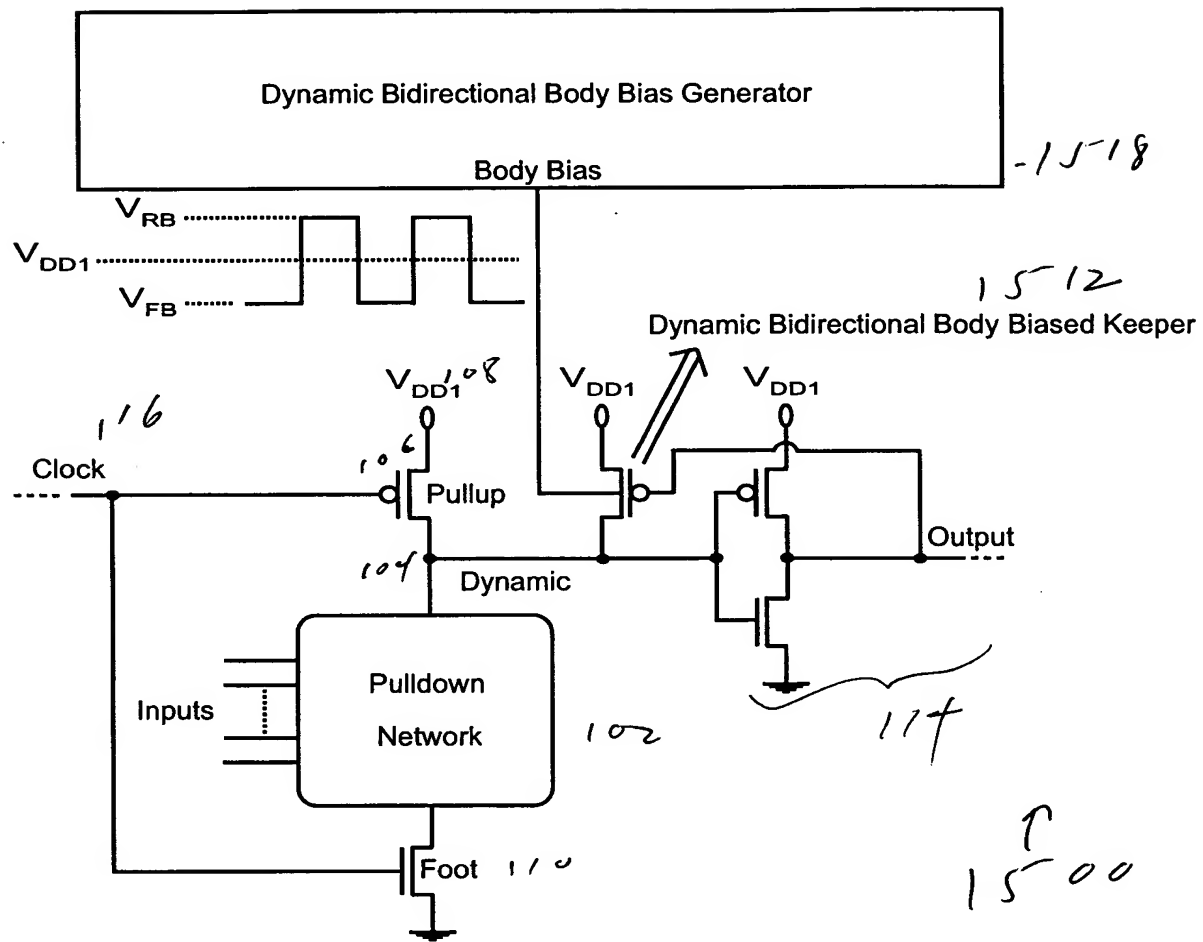
Fig. 15. A footed domino logic circuit based on the dynamic bidirectional body biased keeper domino logic (DBBBKD) circuit technique.
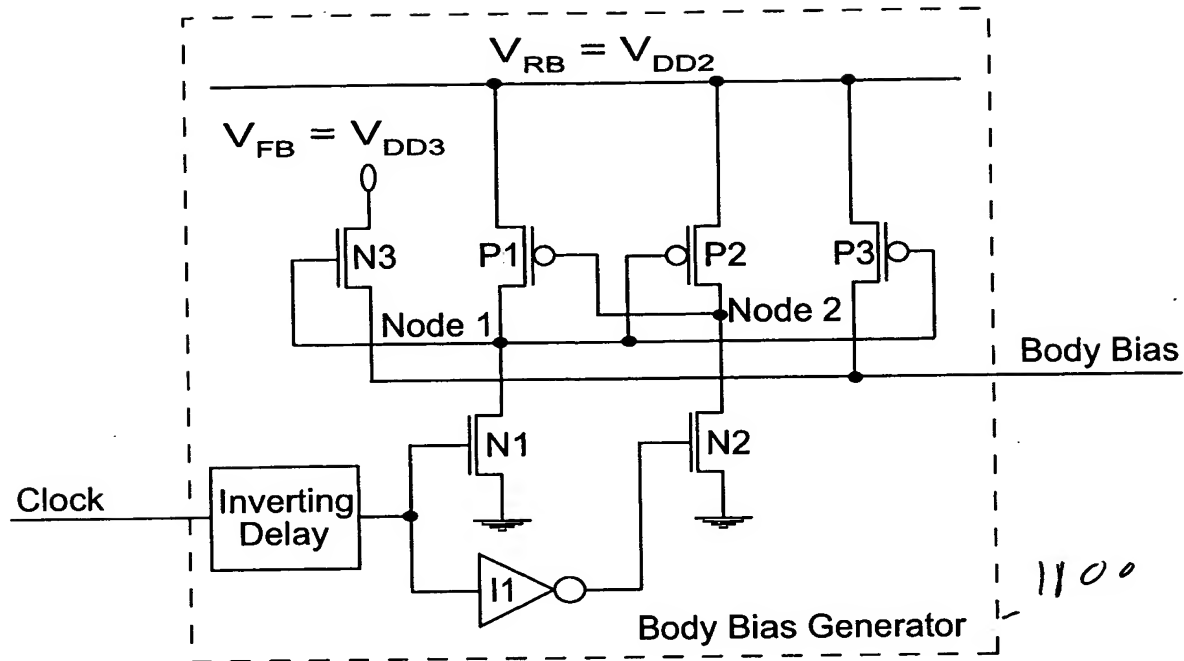
Dynamic Bidirectional Body Bias Generator

Body Bias

1 5 18

V_{RB}

V_{DD1}

V_{FB}

1 5 12

Dynamic Bidirectional Body Biased Keeper

V_{DD1} *108*

V_{DD1}

V_{DD1}

116

Clock

106

Pullup

Output

104

Dynamic

Inputs

Pulldown

Network

102

114

1600

Fig. 16. A footless domino logic circuit based on the dynamic bidirectional body biased keeper domino logic (DBBBKD) circuit technique.

Low-V_t Keeper

Forward Body Biased Keeper

Evaluation Phase

Precharge Phase

Reverse Body Biased Keeper

Reverse Body Biased Keeper

V_{RB}

Body Bias

High-V_t Keeper

High-V_t Keeper

V_{FB}

t_d

V_{DD1}

Clock

Weak Keeper
Fast Evaluation

Strong Keeper
High Noise Immunity

0

V_{DD1}

Input

0

Fig. 17. Waveforms that characterize the operation of the proposed dynamic bidirectional body biased keeper domino logic (DBBBKD) circuit technique ($V_{FB} < V_{DD1} < V_{RB}$).

Fig. 18. A body bias generator applicable to the proposed dynamic bidirectional body biased keeper domino logic (DBBBKD) circuit technique [$V_{DD3} < V_{DD1} < V_{DD2}$ and $V_{tN3} < (V_{DD2}-V_{DD3})$].

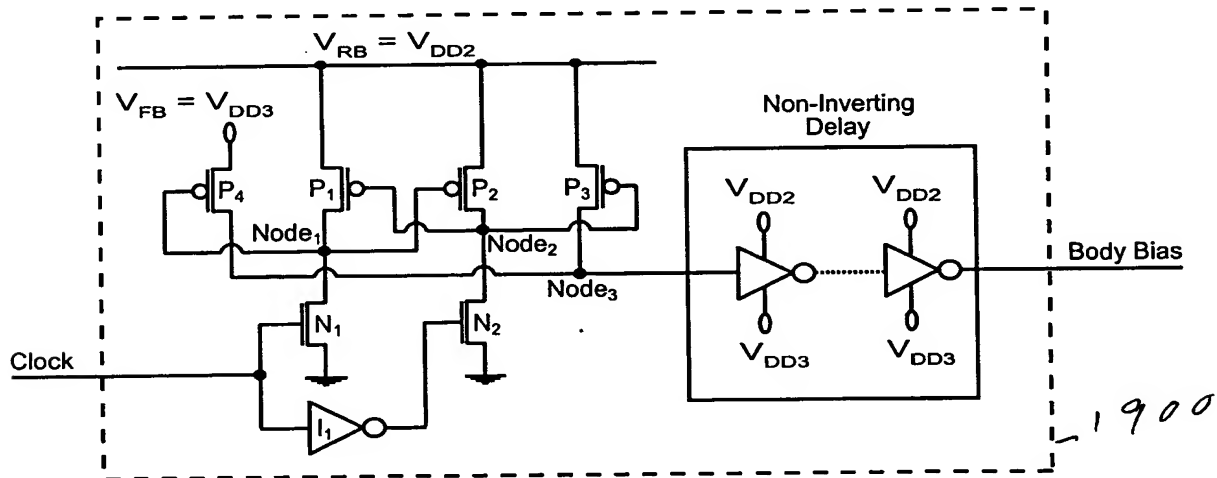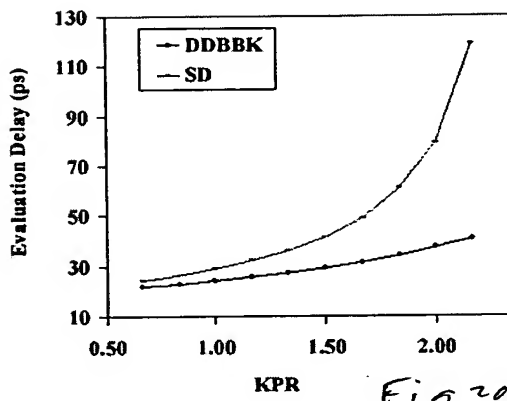

Fig. 19. A body bias generator applicable to the proposed dynamic bidirectional body biased keeper domino logic (DBBBKD) circuit technique ($V_{DD3} < V_{DD1} < V_{DD2}$). The body of P_4 can be connected either to V_{DD2} or to $Node_3$ in order to not turn on the source-to-body diode of P_4 when $Node_3$ transitions to V_{DD2}.
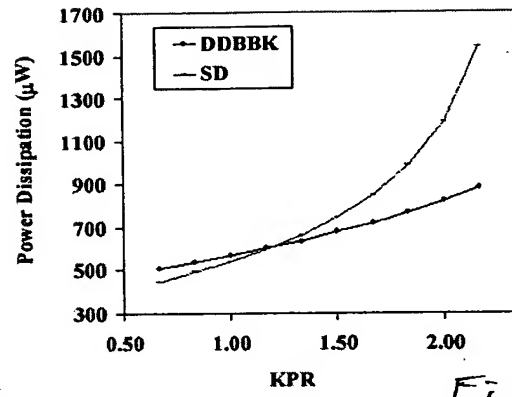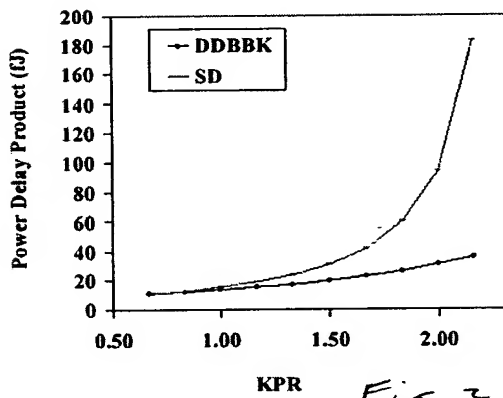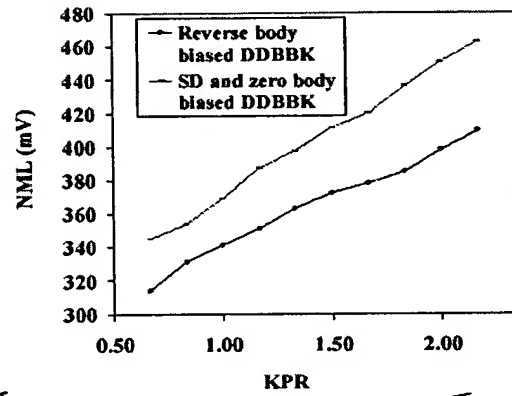
Fig. 20A

Fig. 20B

Fig. 20C

Fig. 20D